

# Measuring Centrality in pA/dA Collisions at RHIC with Grey Protons

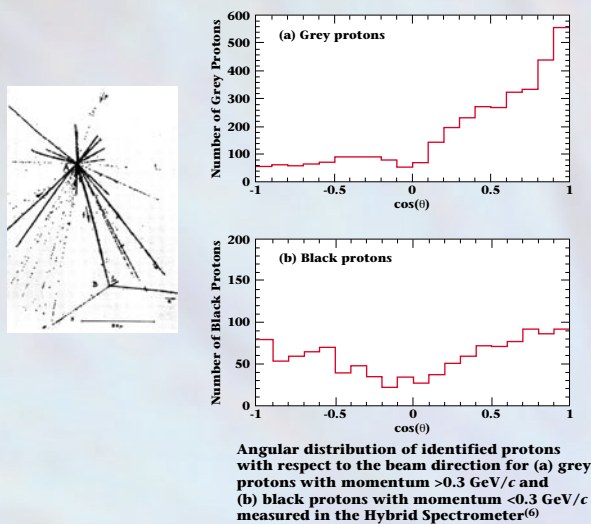
Stephen C. Johnson<sup>1</sup>, Ron A. Soltz<sup>1</sup>, Gerd J. Kunde<sup>2</sup>

<sup>1</sup> Lawrence Livermore National Laboratory, Livermore, CA. <sup>2</sup> Yale University, New Haven, CT.



**Abstract** Traditionally, the centrality in proton-nucleus collisions has been determined from the number of knock-out (grey) and evaporation (black) nucleon. Unfortunately, none of the current RHIC experiments have the capability to measure grey nucleons. We propose a modest calorimetric upgrade located at the ZDC z-position and utilizing a calorimeter previously used by experiment E864 at the AGS to measure these forward protons. The upgrade will be placed at the PHENIX interaction region for the upcoming run cycle at RHIC. However, there are enough calorimeter modules to instrument this upgrade in all 4 interaction regions. This upgrade will allow systematic comparisons and extrapolations of p-A and d-A collisions to A-A.

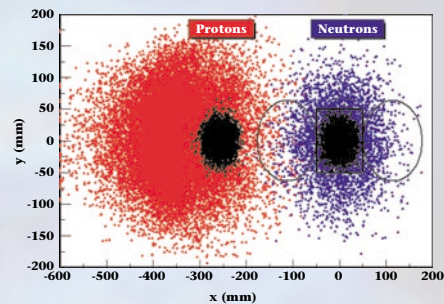
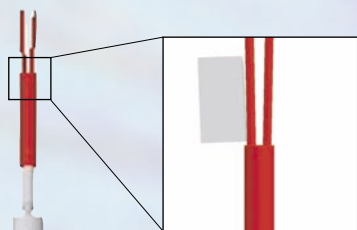
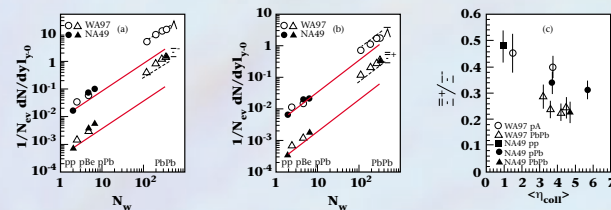
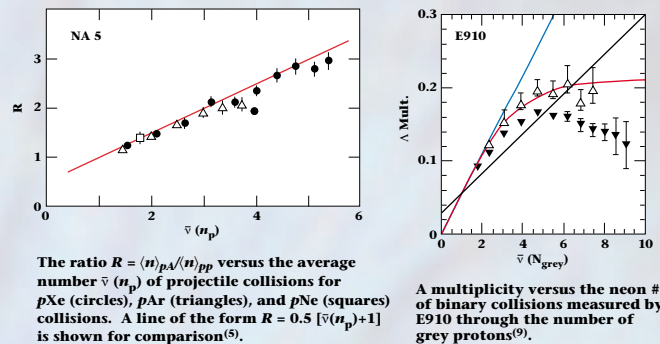
## What are grey and black nucleons?



## References (on p-A centrality)

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7. R. Albrecht, *et al.* (WA80) Z. Phys. C57 (1993) 37.
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9. I. Chemakin, *et al.* (E910) Phys. Rev. Lett. 85 (2000) 4868.
10. T. Sosa for the NA49 Collaboration, Nucl. Phys. A698 (2002) 491c.

## Grey protons have been used in previous p-A experiments to extract interesting physics



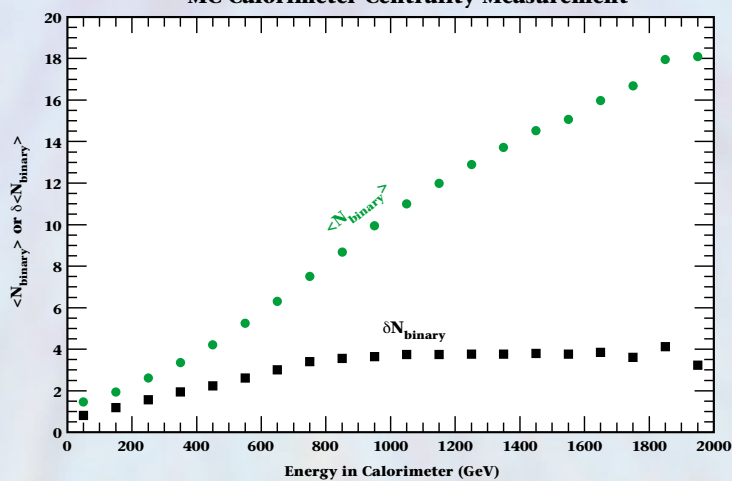
## Calorimeter provides best measure of N<sub>grey/black</sub>



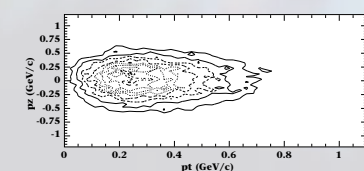
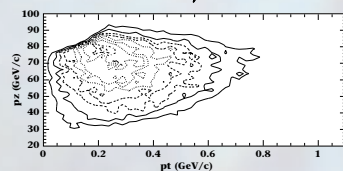
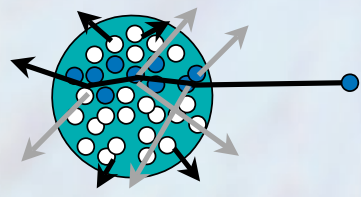
Scrounge-a-cal: Adopt E864 calorimeter, unused for several years at Brookhaven. Place at location of ZDC.

$$\frac{\delta E}{E} = 3.5\% + \frac{34\%}{\sqrt{E}}$$

## MC Calorimeter Centrality Measurement



PHENIX will instrument this upgrade for the upcoming run — other experiments have expressed an interest in an identical instrumentation in the near future



Relationship between the number of binary interactions and the number of grey and black tracks<sup>(4)</sup>.

